Renewable Energy 5: *What transmission upgrade costs and back-up capacity / integration costs have Michiganders absorbed as part of the current renewables standard? Are any of those offset by other benefits of those investments?*

Executive Summary

1. Adding any new generation to the electric grid can require additional transmission and interconnection facilities in order to reliably deliver the power. Transmission costs can be higher if the generation is located in remote areas where the existing grid is not robust. This was the case with wind energy development in Michigan's Thumb area, where the wind resources were optimal but the existing transmission system could not handle the output. In addition, as an intermittent resource, use of wind energy can result in costs to handle fluctuations in output, known as "integration costs."

2. The total cost of transmission and interconnection facilities in Michigan as part of the current RPS and PA 295 requirements is approximately $570 million, resulting in annual charges of over $100 million per year. There are reliability and economic benefits associated with these transmission investments (or the wind generation itself), but they are difficult to quantify.

3. Integration costs have not been specifically quantified for Michigan but several studies provide estimates in the range of $5 per megawatt-hour for intermittent generation resources such as wind and solar.

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1. Adding any new generation to the electric grid can require additional transmission and interconnection facilities in order to reliably deliver the power. Transmission costs can be higher if the generation is located in remote areas where the existing grid is not robust (e.g., wind energy in the Thumb). In addition, as an intermittent resource, use of wind energy can result in costs to handle fluctuations in output, known as "integration costs."

Wind energy is the primary renewable resource being used to meet Michigan's current renewable portfolio standard. Several of the major wind developments in service or planned to comply with the RPS are located in the Thumb, an area rich in wind resources but lacking necessary transmission infrastructure to deliver power from this area to more populated areas. In 2011, ITC *Transmission* commenced construction of a major high-voltage project, known as the "Thumb loop," to export wind energy from this area.[1] The project is slated for completion in 2015 – to align with the RPS requirements – at an estimated cost of $510 million. This investment will result in an annual expense of $100 million for the 40-year life of the transmission system.[2]

Some wind projects in other areas have required transmission upgrades but they have not required significant transmission system expansions. All wind projects require new interconnection facilities to connect to the transmission grid; in Michigan, these interconnection costs are initially paid by the wind developer and then ultimately borne by customers through transmission and/or distribution rates.

[1] Transmission upgrades to interconnect new power plants have typically been constructed to serve an individual plant on a case-by-case basis. But given the time and cost involved in building new transmission lines, this incremental approach can be problematic in areas where a significant amount of wind energy development is expected in aggregate over multiple years. In anticipation of this issue, PA 295 of 2008 laid out a planning process to estimate the total potential for wind energy in wind-rich regions of the state and the transmission upgrades that would be needed to accommodate such wind energy production (see Renewable Energy Question 8 for detail). As part of this process, the Thumb region and a portion of Allegan County were designated by the MPSC as "wind energy zones," which allows for expedited siting approval of the high-voltage transmission facilities by the MPSC. Transmission was not needed in Allegan County and wind projects have not been pursued as a result of additional wind testing.

[2] As the transmission system is depreciated, the $100 million will decrease with time.

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As discussed further under Renewable Energy Questions 6 and 35, wind "integration costs" are costs incurred when operating the electric grid which can be attributed to the variability and uncertainty introduced by wind generation. They include costs associated with having to use other generation on the system to balance fluctuations in output and thereby maintain overall system balance.

2. The total cost of transmission and interconnection facilities in Michigan as part of the current RPS and PA 295 requirements is approximately $570 million, resulting in annual charges of over $100 million per year. There are reliability and economic benefits associated with these investments, but they are difficult to quantify.

Not including the Thumb loop project discussed further below, renewable energy projects to comply with the RPS have resulted in approximately $61 million in interconnection facilities and transmission upgrades to date.[3] These costs were incurred to connect 688 MW of renewable (all wind) generation to the grid. Additional costs are expected over the next few years to connect planned wind projects. The interconnection facilities and other transmission upgrades for individual renewable energy projects are not expected to produce any identifiable system benefits.

It is difficult to examine the cost of transmission related to PA 295 of 2008 absorbed in Michigan without a discussion of the federal and regional transmission policies that directly affect Michigan. MISO is moving forward with a proposal that requires Michigan's electricity customers to pay for renewable-related transmission that is unrelated to the scope of Michigan's 2008 law, and will exceed the cost of transmission directly related to the law. While customers outside of Michigan will pay a share of Michigan's Thumb loop project, Michigan customers will have to pay for a share of out-of-state projects that qualify for this regional cost-sharing treatment proposed by MISO and approved by the Federal Energy Regulatory Commission (this issue is the subject of ongoing litigation). The need for the transmission out of state is largely driven by the renewable energy policies or development activity in those states with renewable projects, including Minnesota, the Dakotas, and Iowa. These out-of-state renewable projects cannot be used toward Michigan's 10% RPS. All of the combined qualifying projects cost an estimated $5.2 billion (including the $510 million for the Thumb project), which means that Michigan's total share of the wind transmission investments is about $1 billion. This results in an annual customer expense of $200 million (about double the annual expense if Michigan paid for the entire Thumb project on its own).

There is considerable dispute over the benefits associated with the Thumb loop project and the transmission projects to be constructed out of state. A MISO study shows that the overall $5 billion investment across the MISO footprint would result in a net benefit to Michigan.[4] The majority of the modeled benefits are in the form of reduced congestion, increased access to lower cost generation, and lower fuel costs. The benefits of these transmission projects are considered for the total portfolio of projects. While the Thumb loop will improve the overall reliability and resiliency of the grid once

[3] MISO Generation Interconnection Queue (4-5-2013). Includes costs for network upgrade and interconnection facilities for renewable energy projects that are in-service or under construction in Michigan as of April 2013, with signed Generation Interconnection Agreement (GIA) between 2008 through April 2013. Does not include: (1) $1.98 million for 3 MW project that went into service in 2007 (before PA 295) but had signed GIA in 2009, and (2) estimated costs for additional planned projects without signed GIA.

[4] See MISO, Multi Value Project Portfolio, Detailed Business Case. MISO's study suggests that Michigan's benefit/cost ratio for these combined investments ranges from 1.7–3.0 in benefits for every dollar spent in the Lower Peninsula and 2.0–3.3 in benefits for every dollar spent in the Upper Peninsula. These numbers are disputed and subject to ongoing litigation.

it is in service, these reliability benefits can be difficult to quantify.[5] The economic benefit associated with the transmission expansion in Michigan's Thumb region stems from the higher capacity factor of the wind projects in the Thumb compared to the wind projects that may be located in areas with lower wind quality but near more robust areas of the transmission system. That is, each MW of wind capacity installed in the Thumb produces more electricity in MWh over the course of the year than a wind farm in other parts of the state. Using a rough estimate, the incremental value from the energy produced by locating wind projects in the Thumb is around $1 billion over 25 years, or $40 million annually on a nominal basis. This is based on the incremental output from wind projects that are or will be located in the Thumb to meet Michigan's 10% RPS as opposed to locating those projects elsewhere.

3. Integration costs have not been specifically quantified for Michigan but several studies provide estimates.

The North American Electric Reliability Assessment projects that the growth in wind, solar, and other variable resources represents the largest integration effort in the history of the electric industry.[6] The integration costs specific to renewable energy in Michigan have not been quantified but there are several studies that estimate these costs in other states or multi-state regions. For example, the National Renewable Energy Laboratory's (NREL) Eastern Wind Integration and Transmission Study estimated these costs to be approximately $5 per megawatt-hour (MWh) of wind energy.[7] The integration costs in the NREL study were based on 20% to 30% wind energy by 2024 across the Eastern United States—about a tenfold increase over the 2009 baseline amount in this region (and considerably more than the 10% required under Michigan's RPS alone). The $5/MWh amount is not insignificant as it represents about 8% of the MWh price under recent wind contracts executed in Michigan. The estimated integration costs do not include back-up capacity. See Renewable Energy Question 6 for additional detail on this topic.

[5] By way of example, improved voltage regulation resulting from the transmission expansion could alter generation output and thereby lower associated costs and/or allow greater opportunities for large users of energy to locate or expand their business operations in the Thumb.

[6] North American Electric Reliability Council, Special Report: Accommodating High Levels of Variable Generation, www.nerc.com.

[7] National Renewable Energy Laboratory, Eastern Wind Integration and Transmission Study, pp. 28, 29, 45-47. Available at http://www.nrel.gov/docs/fy11osti/47078.pdf..